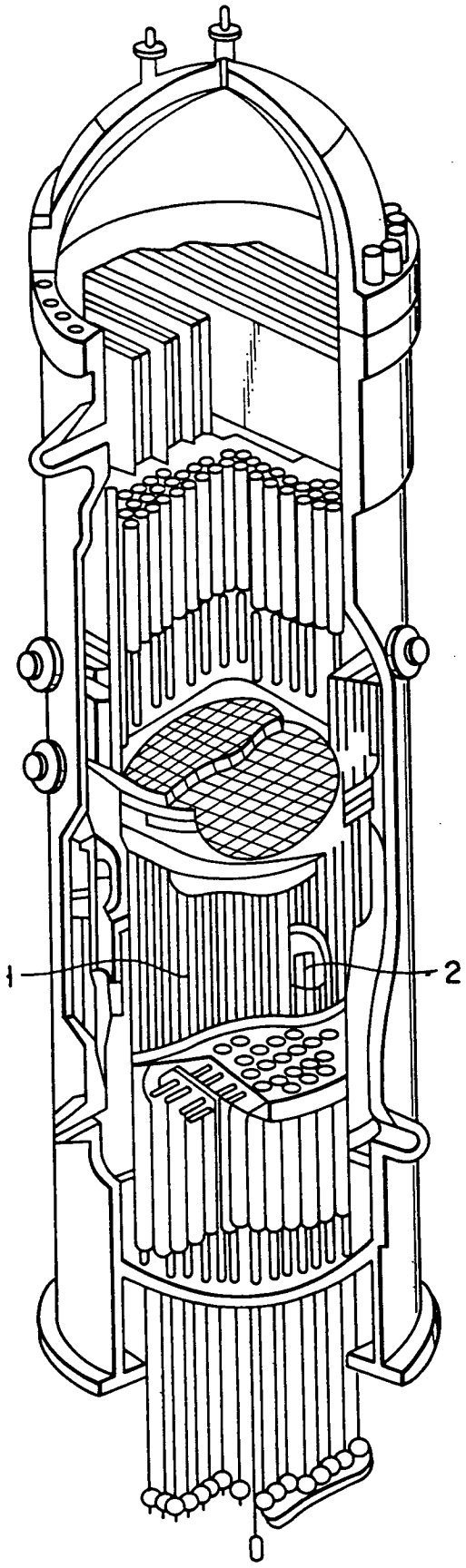


FIG. 1

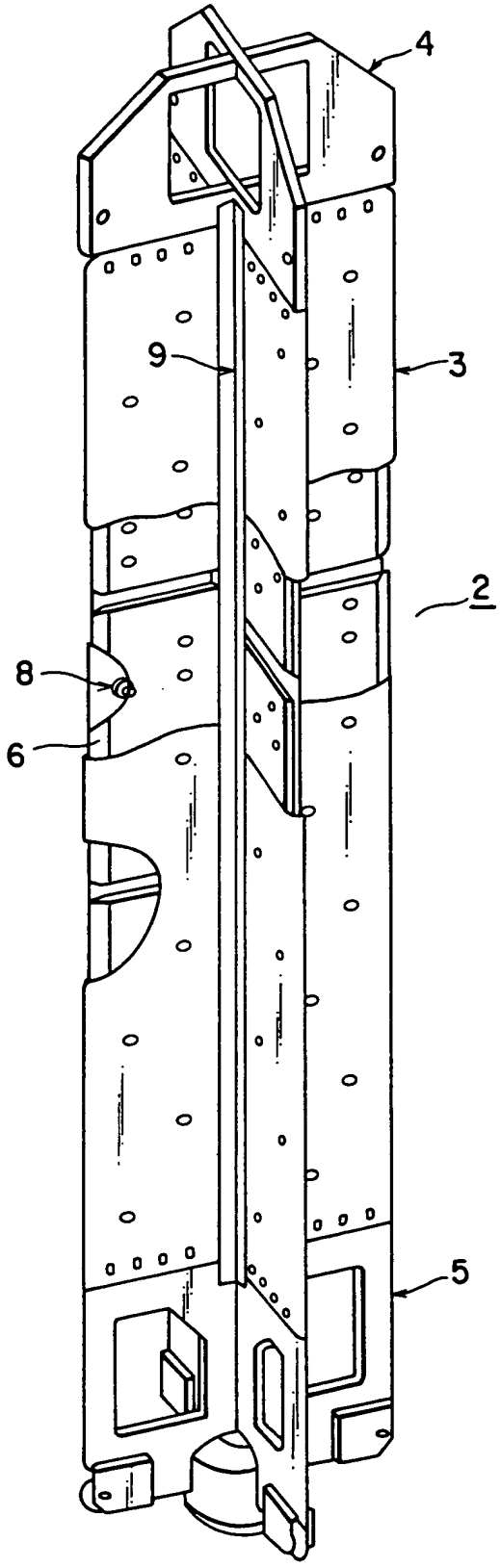


FIG. 2A

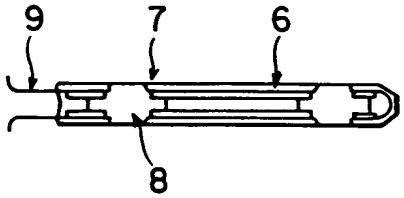


FIG. 2B

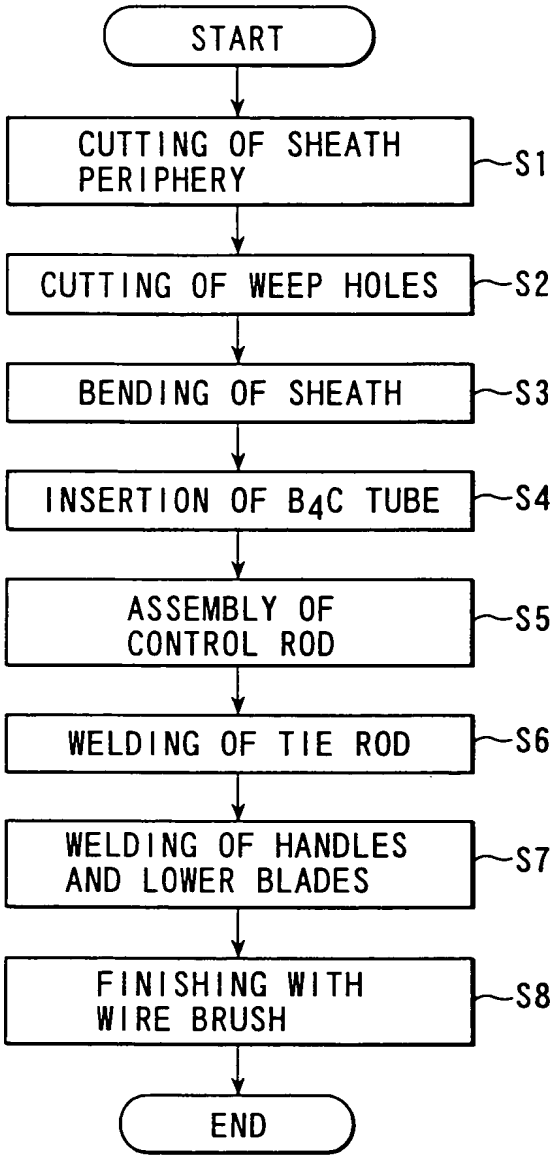


FIG. 3A
PRIOR ART

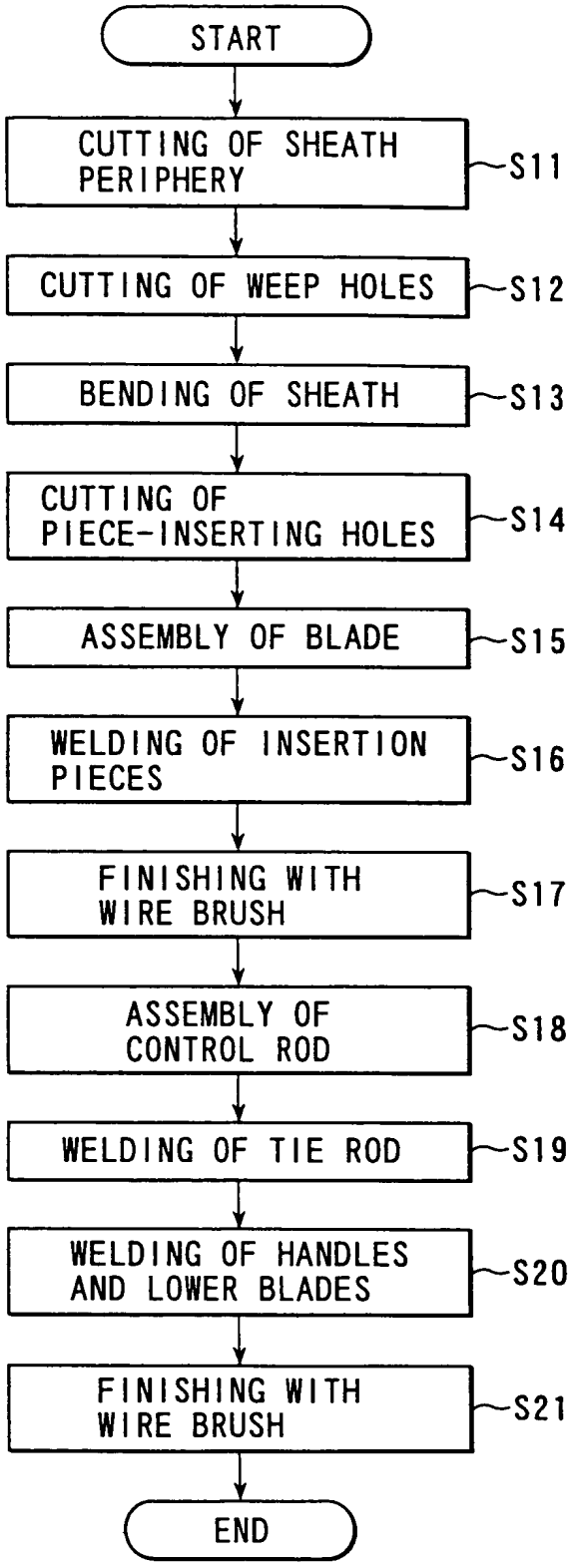


FIG. 3B
PRIOR ART

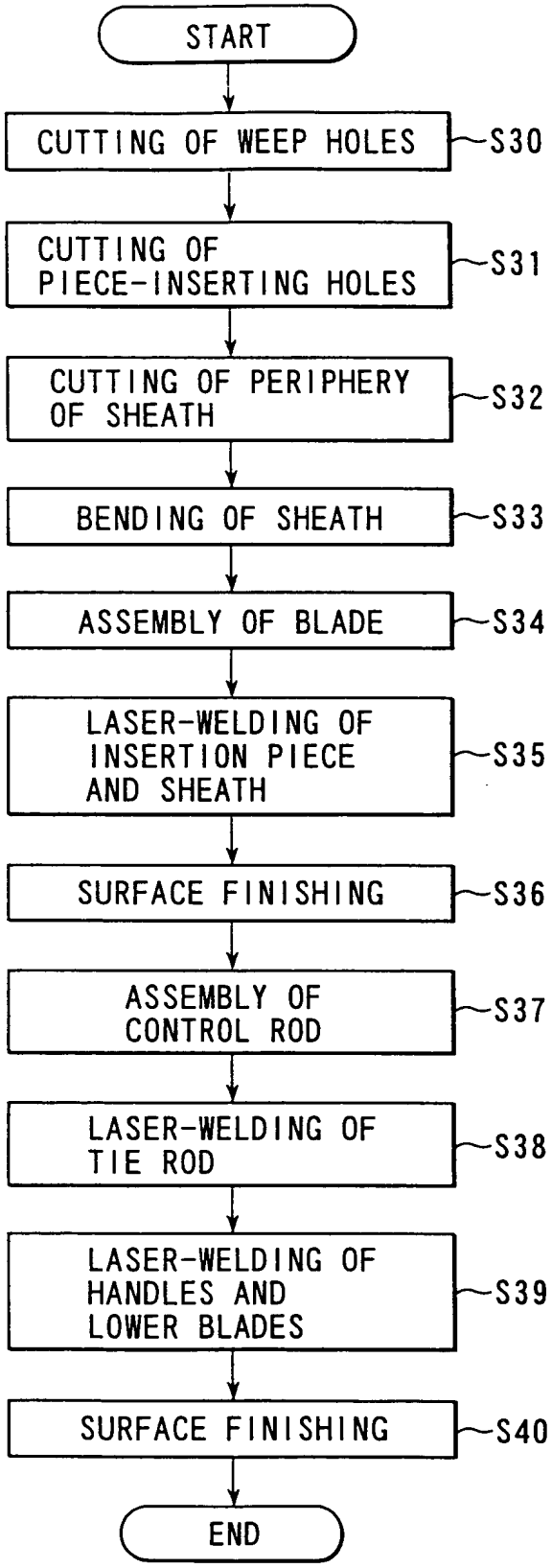

START
CUTTING OF WEEP HOLES
S30
CUTTING OF PIECE-INSERTING HOLES
S31
CUTTING OF PERIPHERY OF SHEATH
S32
BENDING OF SHEATH
S33
ASSEMBLY OF BLADE
S34
LASER-WELDING OF INSERTION PIECE AND SHEATH
S35
SURFACE FINISHING
S36
ASSEMBLY OF CONTROL ROD
S37
LASER-WELDING OF TIE ROD
S38
LASER-WELDING OF HANDLES AND LOWER BLADES
S39
SURFACE FINISHING
S40
END

FIG. 4

OUTPUT (W)	CONVERGENCE DIAMETER (mm)	PEAK OUTPUT (W)	FREQUENCY (Hz)	DUTY (%)	PROCESS SPEED (m/min)	LENS (INCH)
500～2000	0.5～1.0	500～2000	10～1000	10～60	0.1～10	5～10

FIG. 5A

OUTPUT (W)	CONVERGENCE DIAMETER (mm)	PROCESS SPEED (m/min)	LENS (INCH)
500～2000	0.5～1.0	0.1～10	5～10

FIG. 5B

OBLON, SPIVAK, ET AL
DOCKET #: 243346US-2S DIV
INV: Yuji YAMADA ET AL.
SHEET 5 OF 18

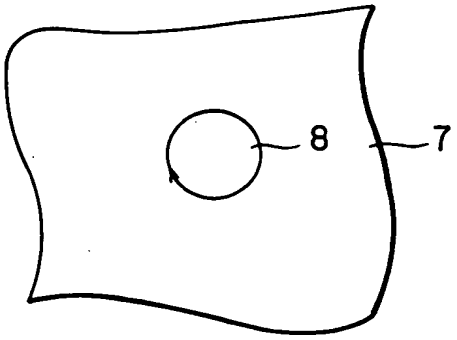


FIG. 6A

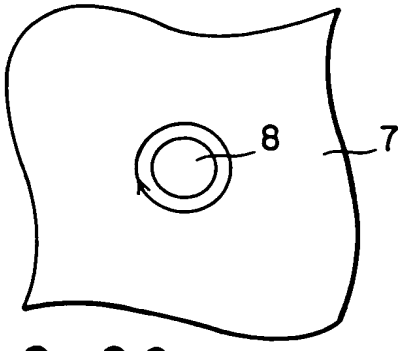


FIG. 6C

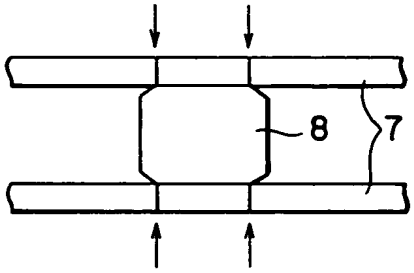


FIG. 6B

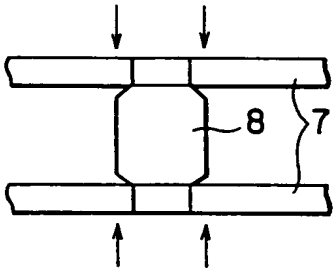


FIG. 6D

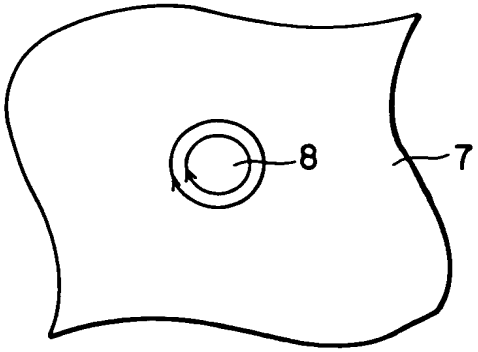


FIG. 6E

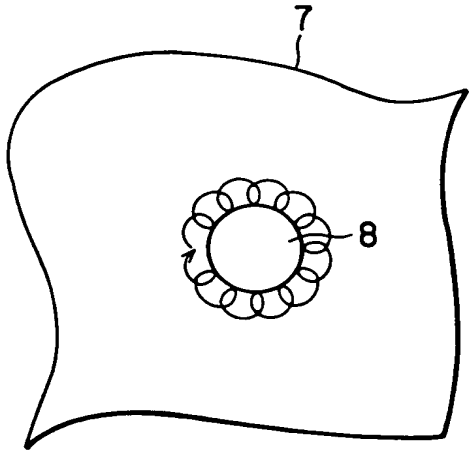


FIG. 7A

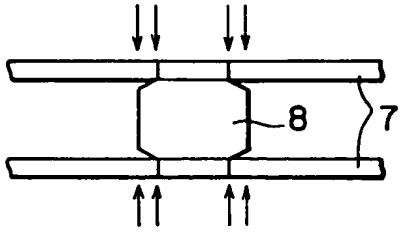


FIG. 6F

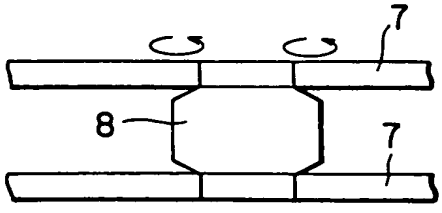


FIG. 7B

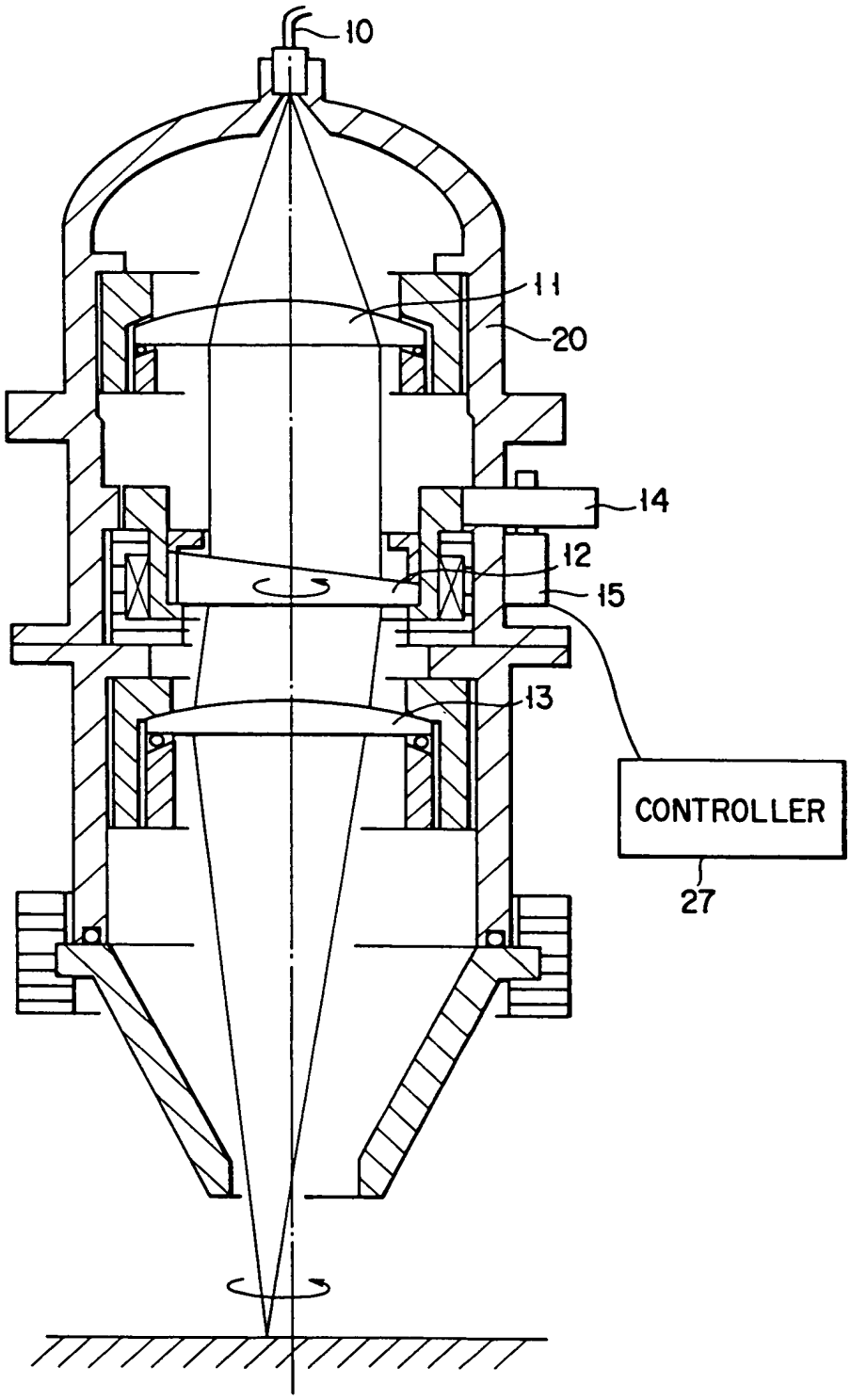


FIG. 8

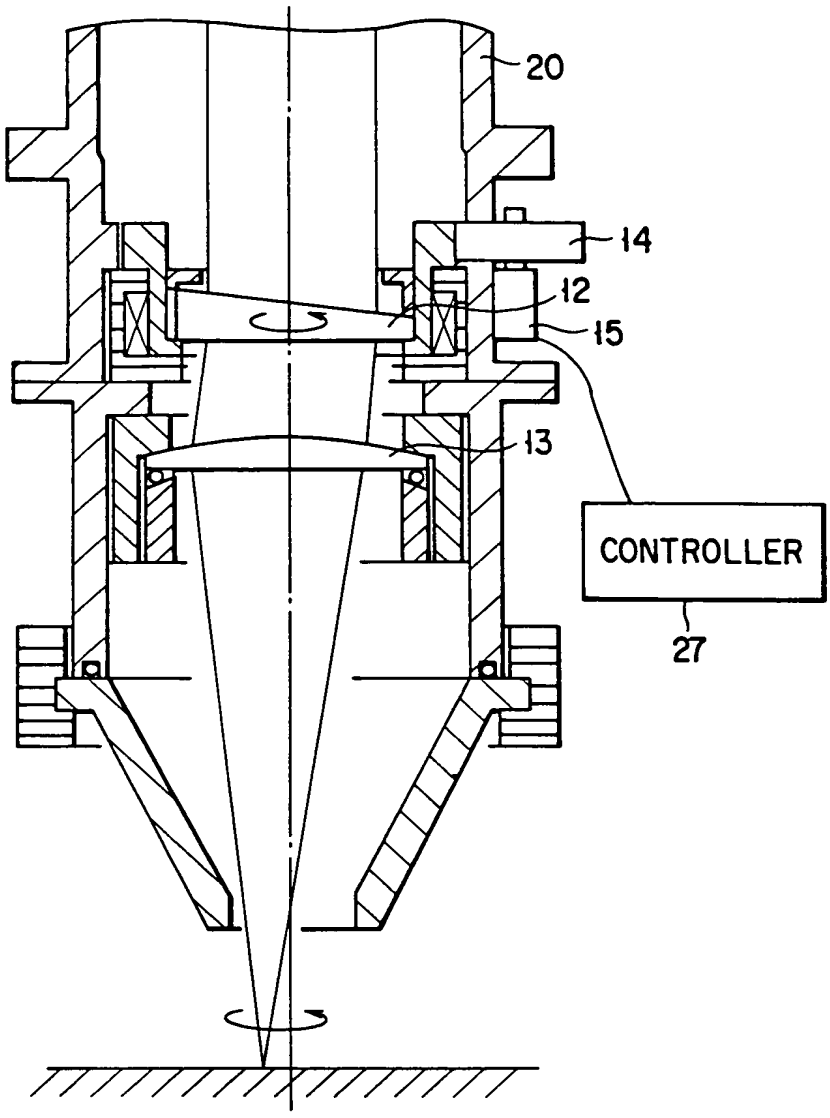


FIG. 9

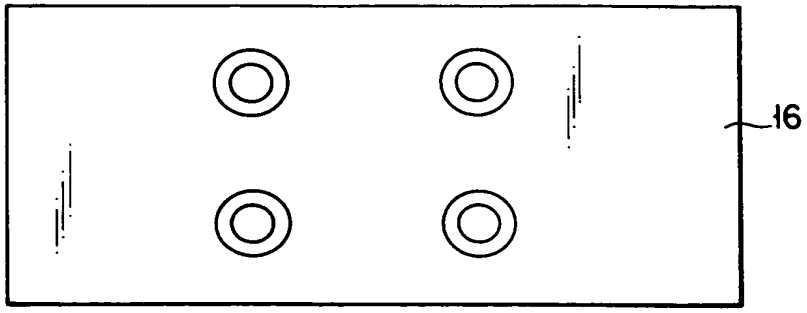


FIG. 10A

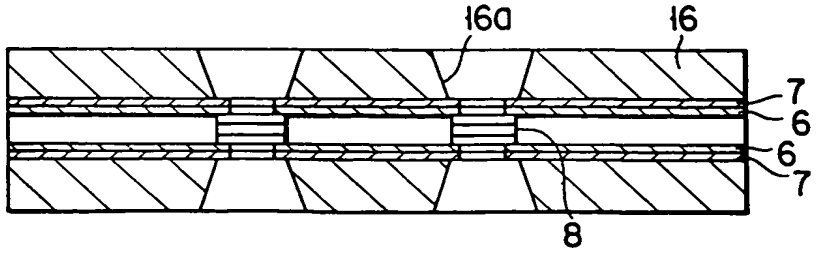


FIG. 10B

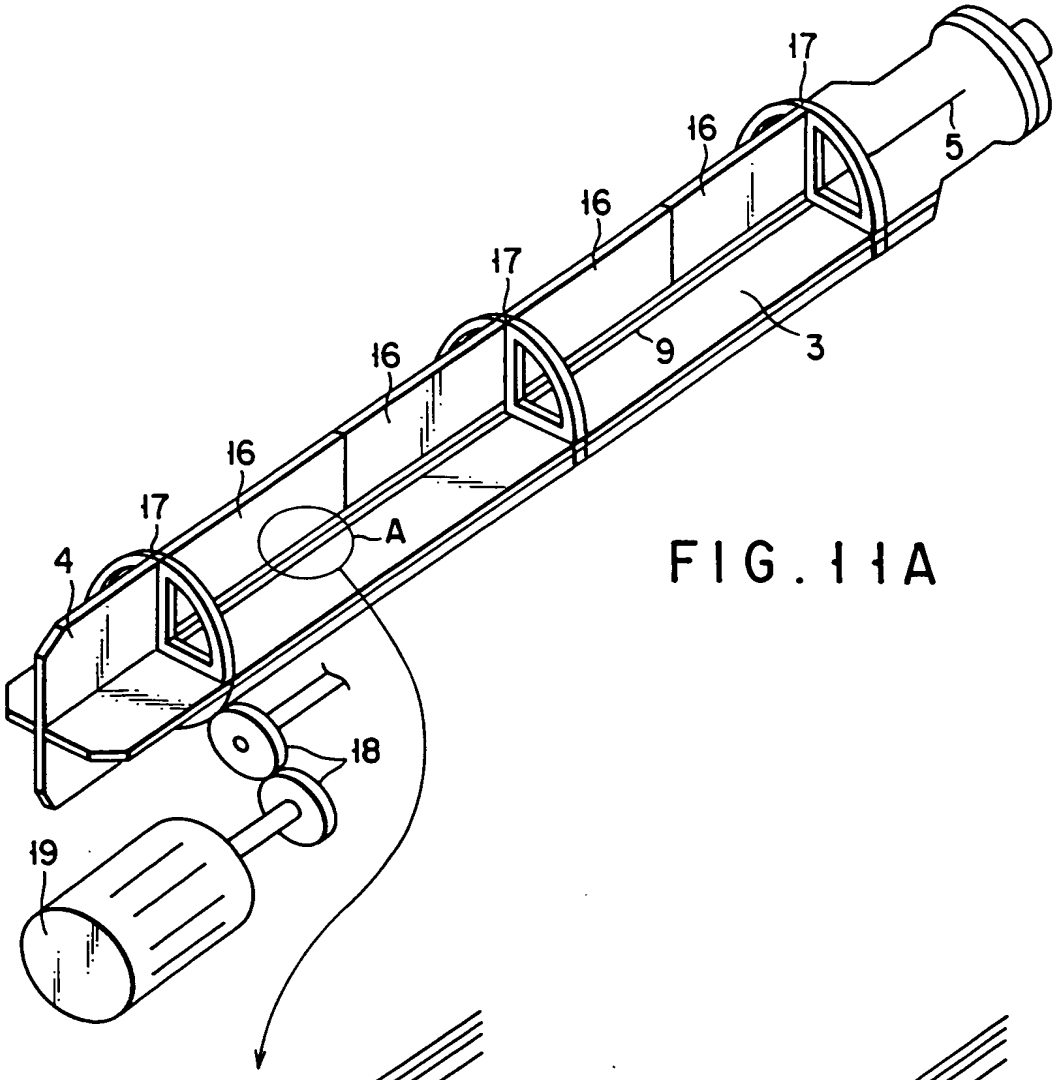


FIG. 11A

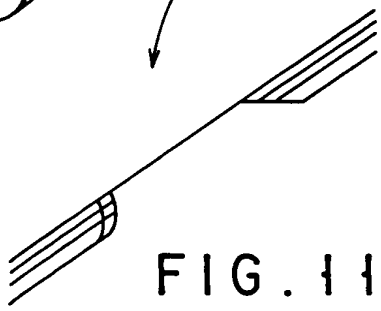


FIG. 11D

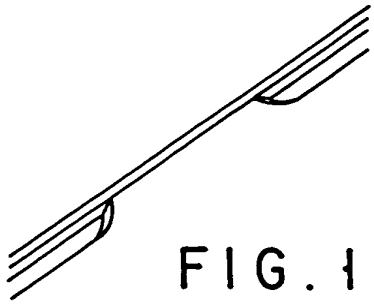


FIG. 11E

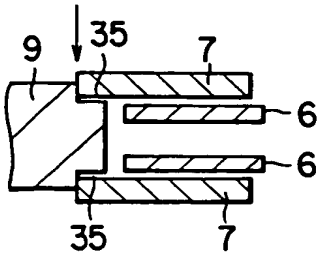


FIG. 11B

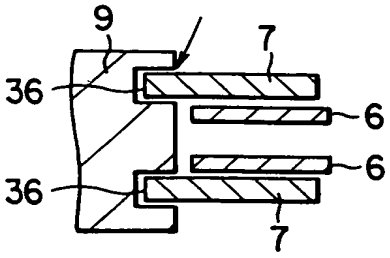
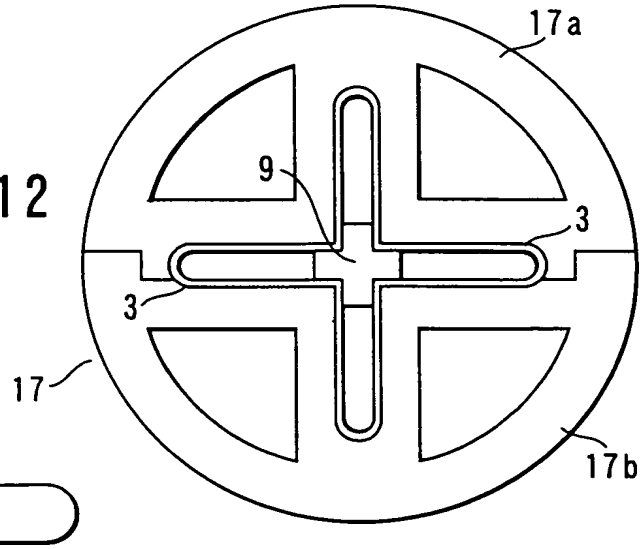


FIG. 11C

FIG. 12



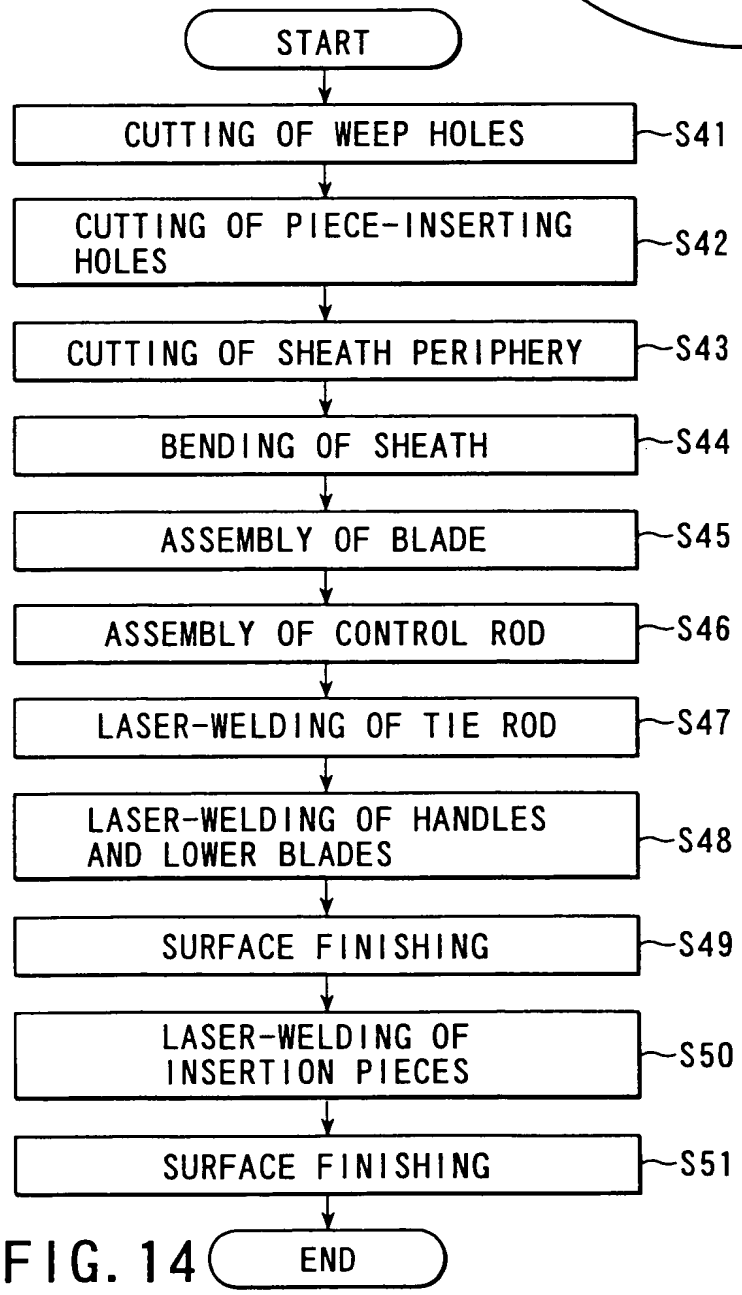


FIG. 14

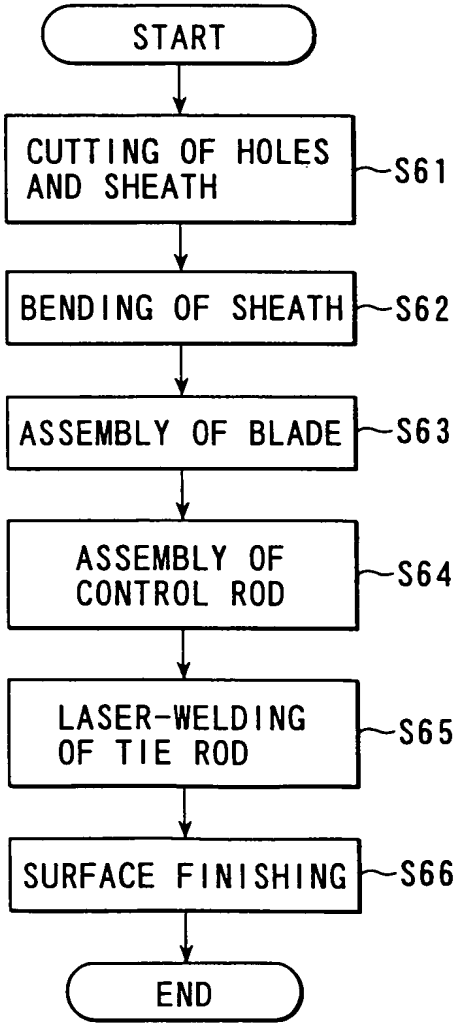


FIG. 15

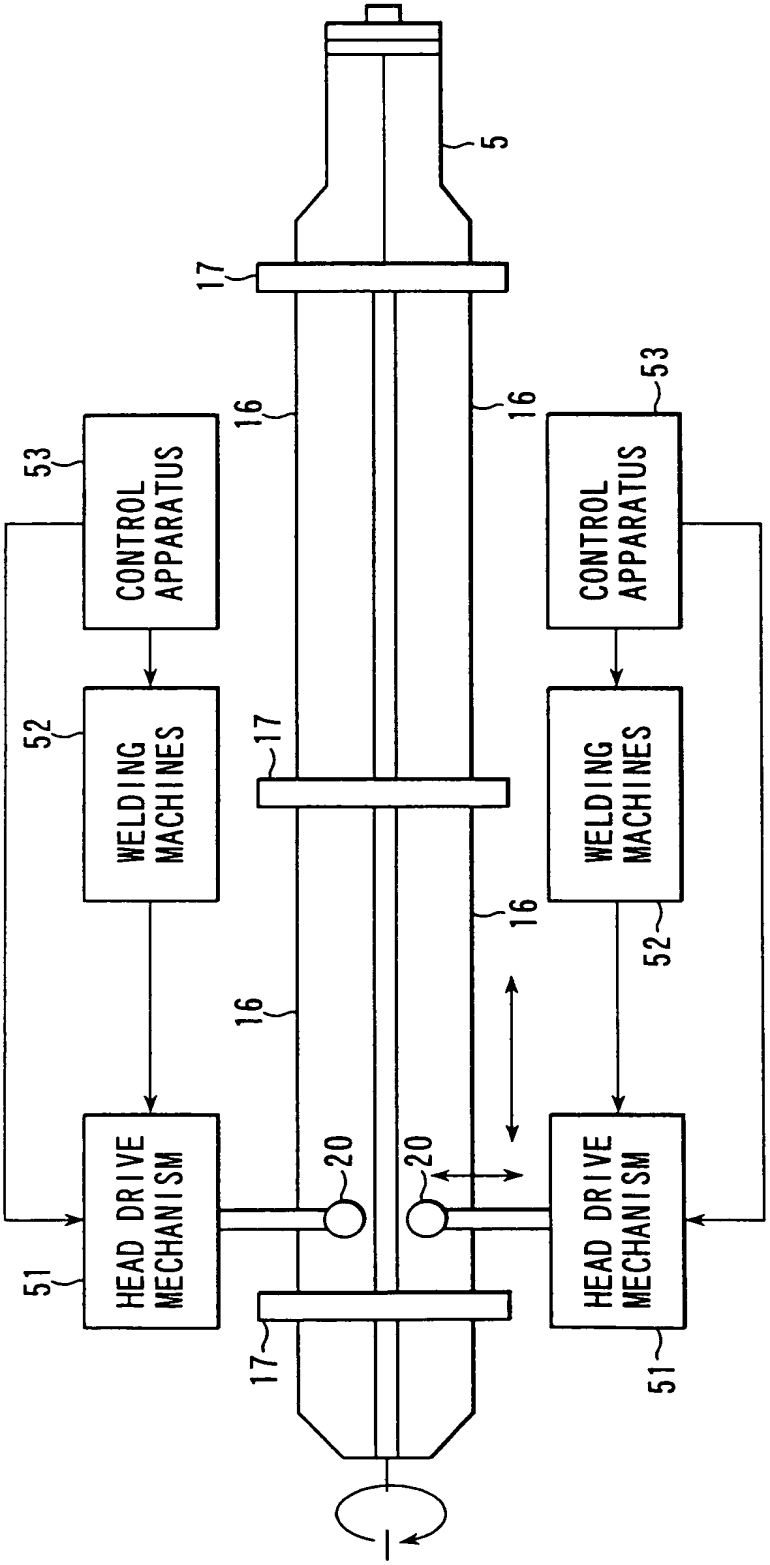

5
17
16
16
53
53
CONTROL APPARATUS
CONTROL APPARATUS
52
WELDING MACHINES
17
WELDING MACHINES
16
52
16
20
20
HEAD DRIVE MECHANISM
HEAD DRIVE MECHANISM
51
17
51

FIG. 13

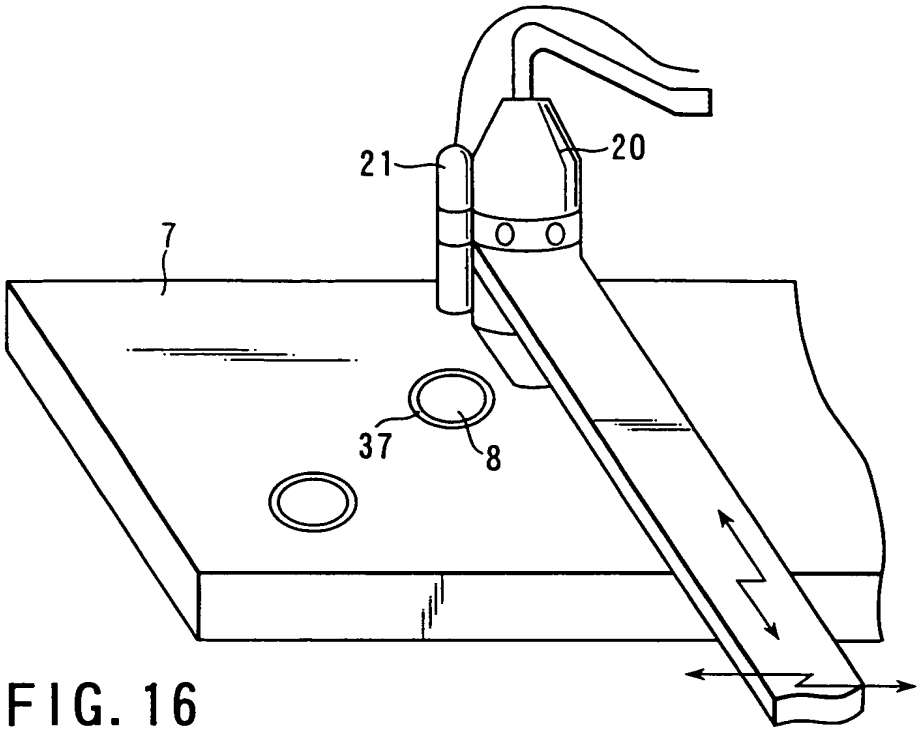

21
20
7
37
8

FIG. 16

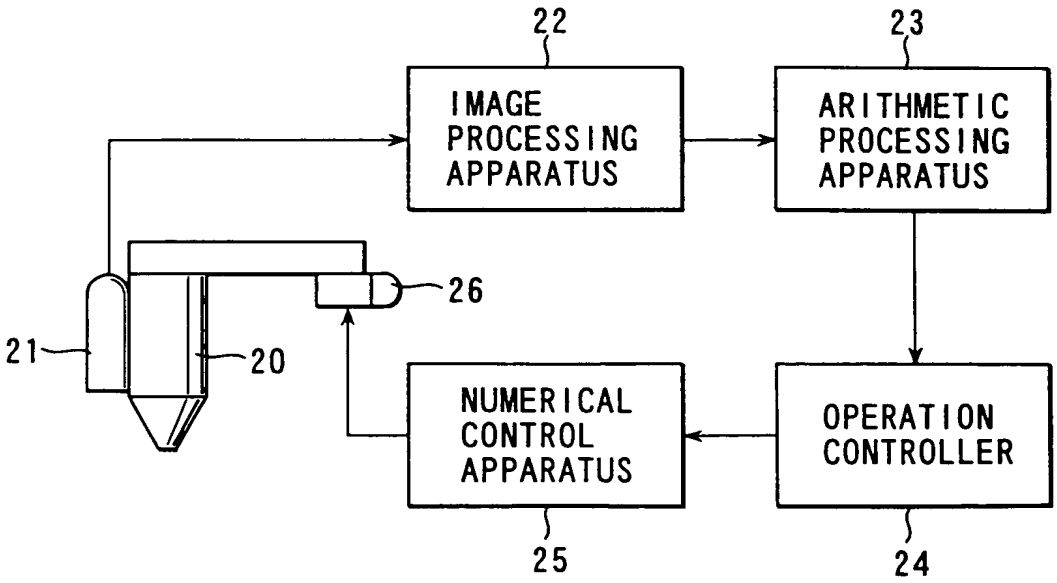

22
IMAGE PROCESSING APPARATUS
23
ARITHMETIC PROCESSING APPARATUS
26
21
20
NUMERICAL CONTROL APPARATUS
OPERATION CONTROLLER
25
24

FIG. 17

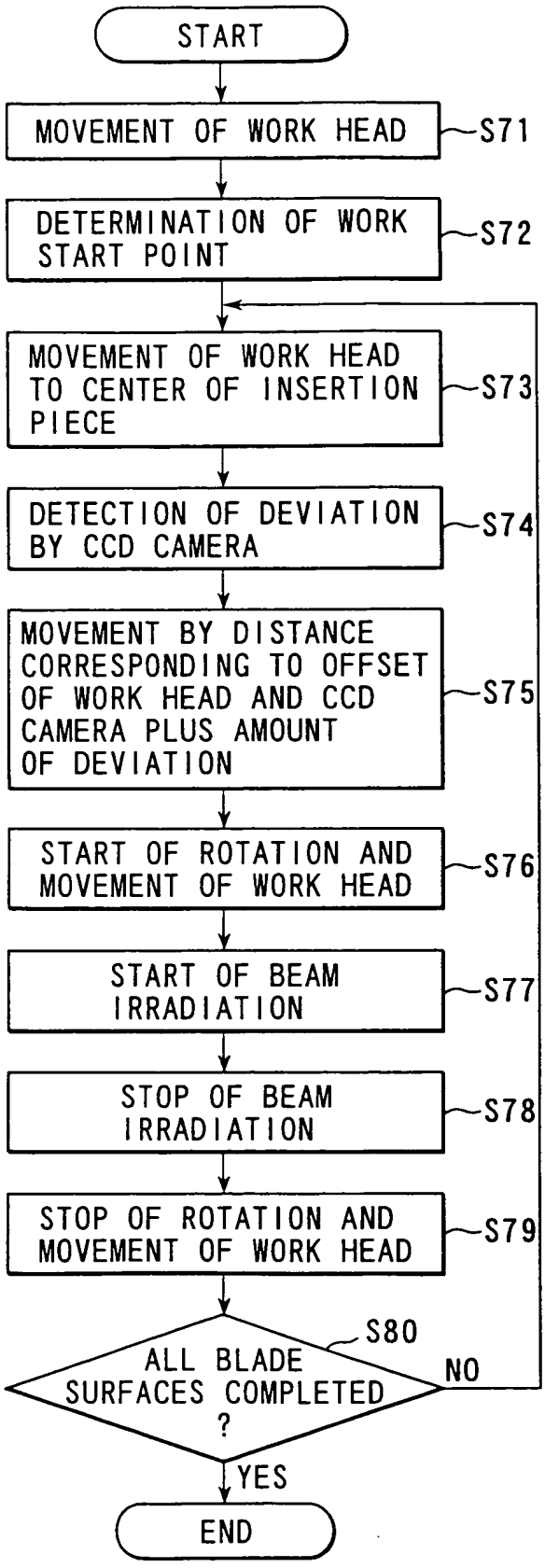

START
MOVEMENT OF WORK HEAD
S71
DETERMINATION OF WORK START POINT
S72
MOVEMENT OF WORK HEAD TO CENTER OF INSERTION PIECE
S73
DETECTION OF DEVIATION BY CCD CAMERA
S74
MOVEMENT BY DISTANCE CORRESPONDING TO OFFSET OF WORK HEAD AND CCD CAMERA PLUS AMOUNT OF DEVIATION
S75
START OF ROTATION AND MOVEMENT OF WORK HEAD
S76
START OF BEAM IRRADIATION
S77
STOP OF BEAM IRRADIATION
S78
STOP OF ROTATION AND MOVEMENT OF WORK HEAD
S79
ALL BLADE SURFACES COMPLETED ?
S80
NO
YES
END

FIG. 18

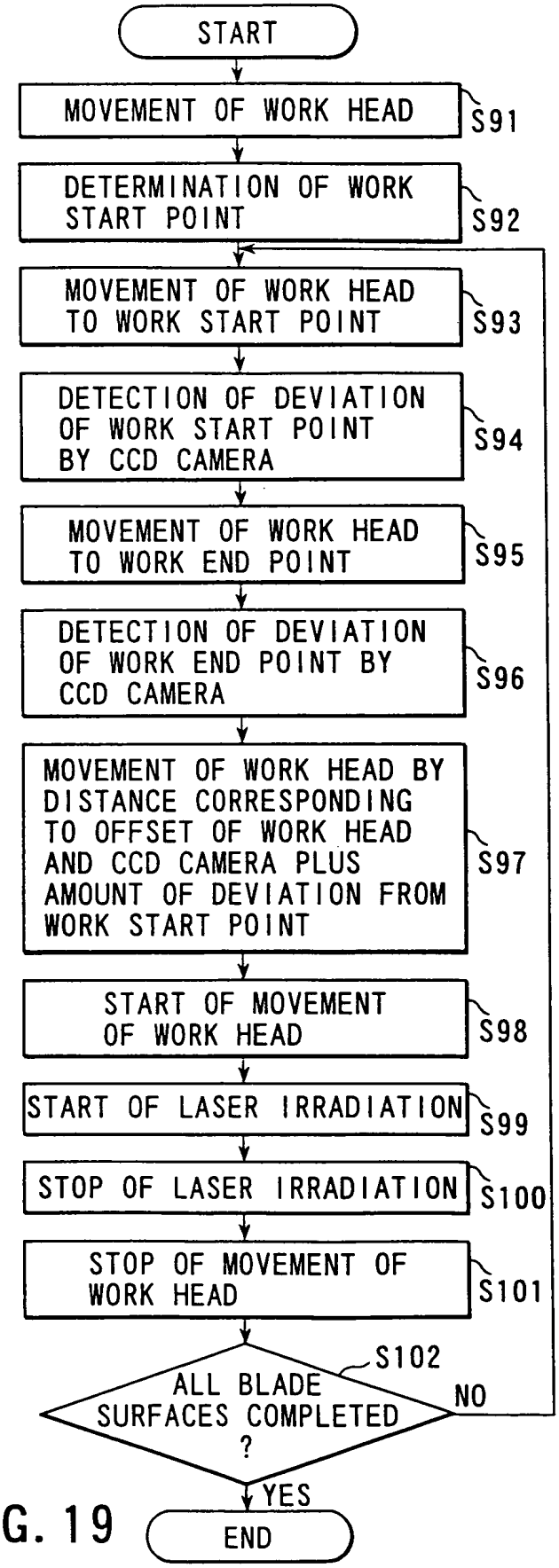

START
MOVEMENT OF WORK HEAD
S91
DETERMINATION OF WORK START POINT
S92
MOVEMENT OF WORK HEAD TO WORK START POINT
S93
DETECTION OF DEVIATION OF WORK START POINT BY CCD CAMERA
S94
MOVEMENT OF WORK HEAD TO WORK END POINT
S95
DETECTION OF DEVIATION OF WORK END POINT BY CCD CAMERA
S96
MOVEMENT OF WORK HEAD BY DISTANCE CORRESPONDING TO OFFSET OF WORK HEAD AND CCD CAMERA PLUS AMOUNT OF DEVIATION FROM WORK START POINT
S97
START OF MOVEMENT OF WORK HEAD
S98
START OF LASER IRRADIATION
S99
STOP OF LASER IRRADIATION
S100
STOP OF MOVEMENT OF WORK HEAD
S101
ALL BLADE SURFACES COMPLETED ?
S102
NO
YES
END

FIG. 19

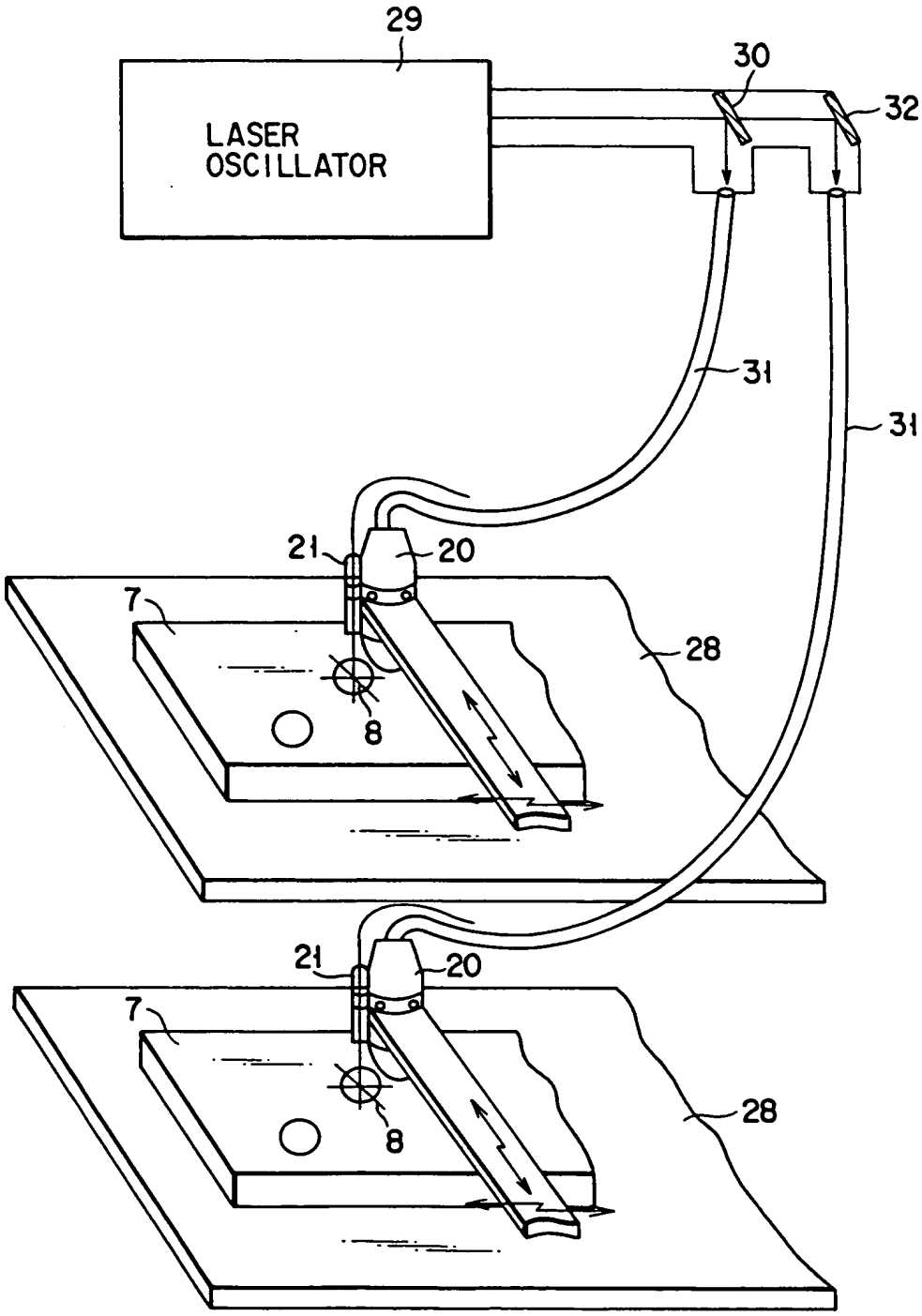


FIG. 20

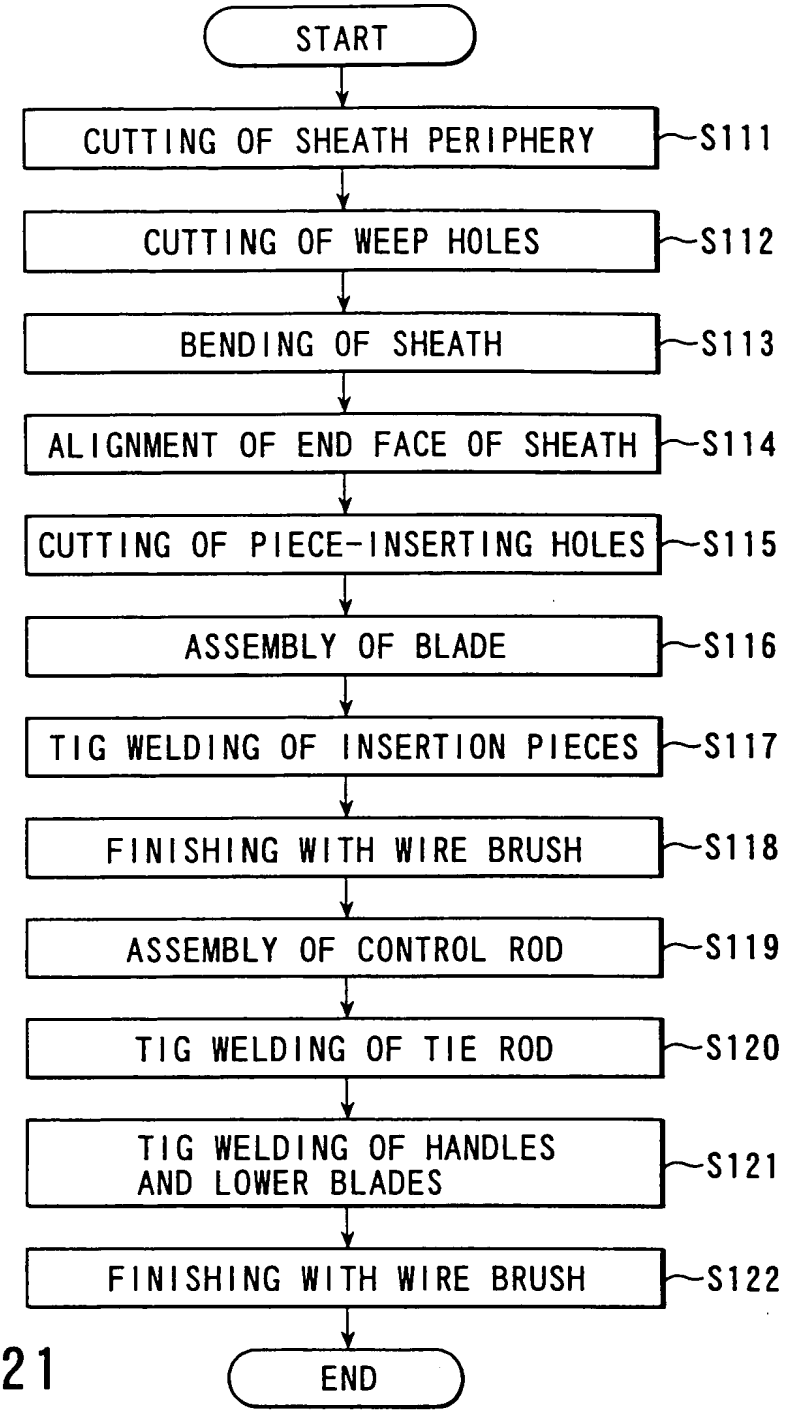


FIG. 21

FIG. 22

WELDING CURRENT (A)	WELDING VOLTAGE (V)	WELDING SPEED (cm/min)
30～100	7～11	3～15

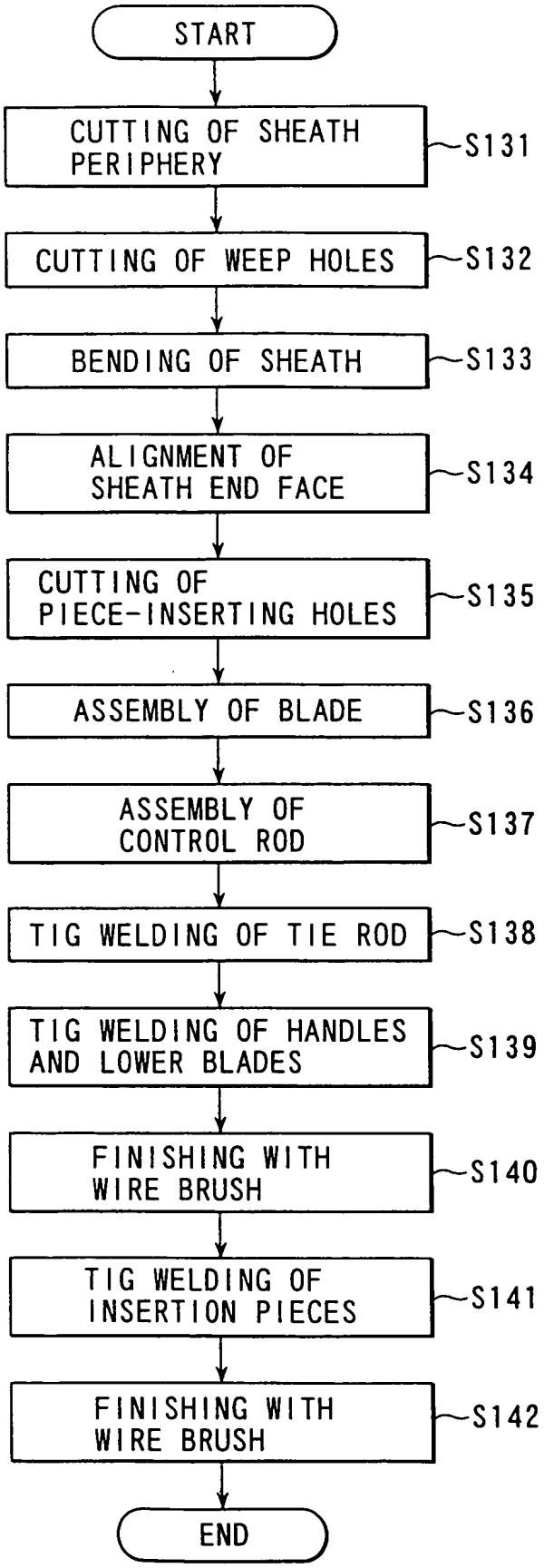

START
CUTTING OF SHEATH PERIPHERY
S131
CUTTING OF WEEP HOLES
S132
BENDING OF SHEATH
S133
ALIGNMENT OF SHEATH END FACE
S134
CUTTING OF PIECE-INSERTING HOLES
S135
ASSEMBLY OF BLADE
S136
ASSEMBLY OF CONTROL ROD
S137
TIG WELDING OF TIE ROD
S138
TIG WELDING OF HANDLES AND LOWER BLADES
S139
FINISHING WITH WIRE BRUSH
S140
TIG WELDING OF INSERTION PIECES
S141
FINISHING WITH WIRE BRUSH
S142
END

FIG. 23

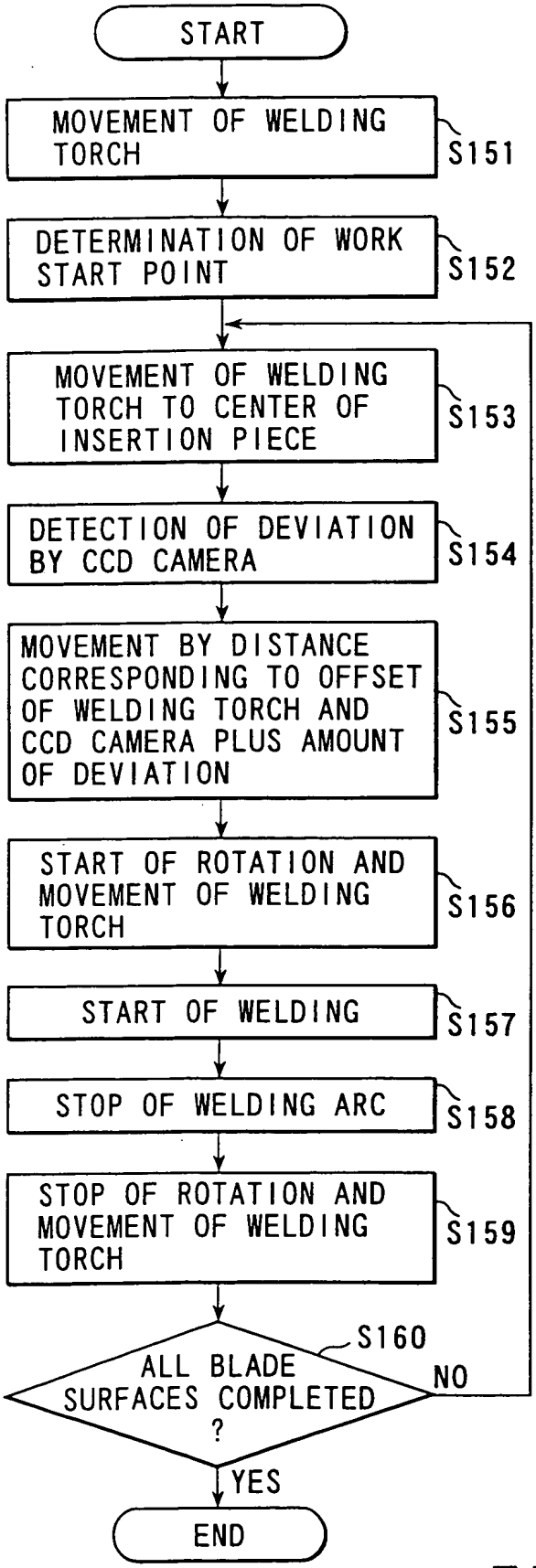

START
MOVEMENT OF WELDING TORCH
S151
DETERMINATION OF WORK START POINT
S152
MOVEMENT OF WELDING TORCH TO CENTER OF INSERTION PIECE
S153
DETECTION OF DEVIATION BY CCD CAMERA
S154
MOVEMENT BY DISTANCE CORRESPONDING TO OFFSET OF WELDING TORCH AND CCD CAMERA PLUS AMOUNT OF DEVIATION
S155
START OF ROTATION AND MOVEMENT OF WELDING TORCH
S156
START OF WELDING
S157
STOP OF WELDING ARC
S158
STOP OF ROTATION AND MOVEMENT OF WELDING TORCH
S159
ALL BLADE SURFACES COMPLETED ?
S160
NO
YES
END

FIG. 24

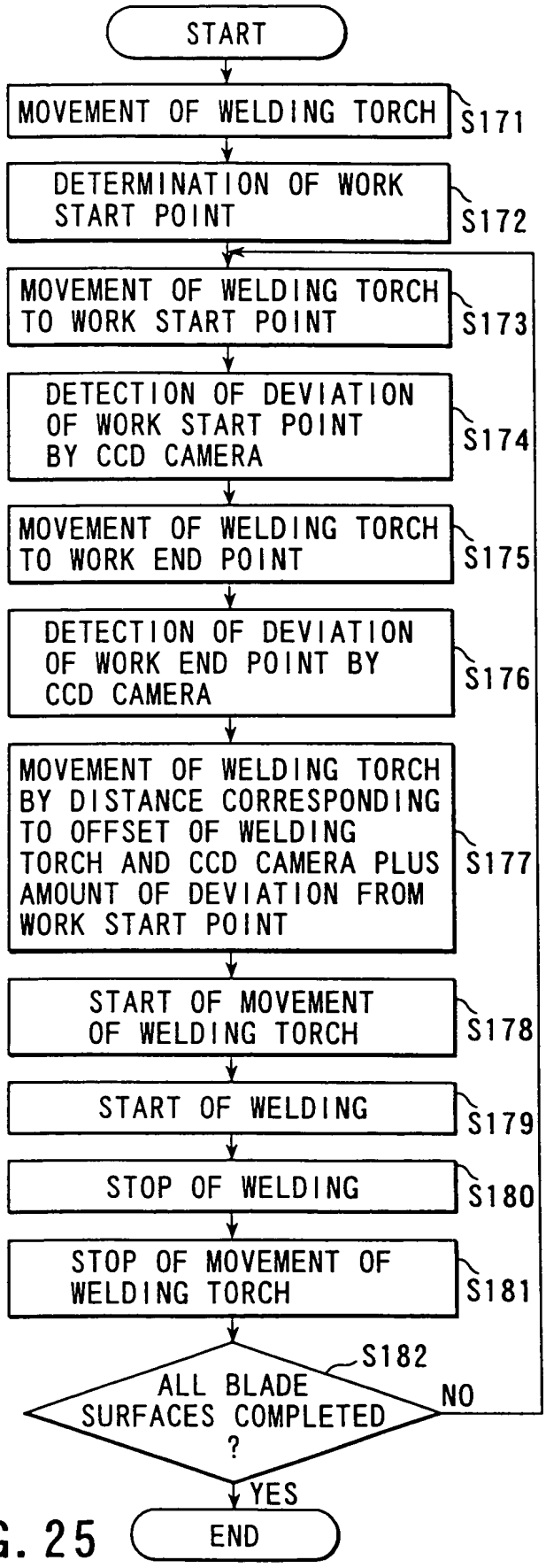

START
MOVEMENT OF WELDING TORCH
S171
DETERMINATION OF WORK START POINT
S172
MOVEMENT OF WELDING TORCH TO WORK START POINT
S173
DETECTION OF DEVIATION OF WORK START POINT BY CCD CAMERA
S174
MOVEMENT OF WELDING TORCH TO WORK END POINT
S175
DETECTION OF DEVIATION OF WORK END POINT BY CCD CAMERA
S176
MOVEMENT OF WELDING TORCH BY DISTANCE CORRESPONDING TO OFFSET OF WELDING TORCH AND CCD CAMERA PLUS AMOUNT OF DEVIATION FROM WORK START POINT
S177
START OF MOVEMENT OF WELDING TORCH
S178
START OF WELDING
S179
STOP OF WELDING
S180
STOP OF MOVEMENT OF WELDING TORCH
S181
ALL BLADE SURFACES COMPLETED ?
S182
NO
YES
END

FIG. 25

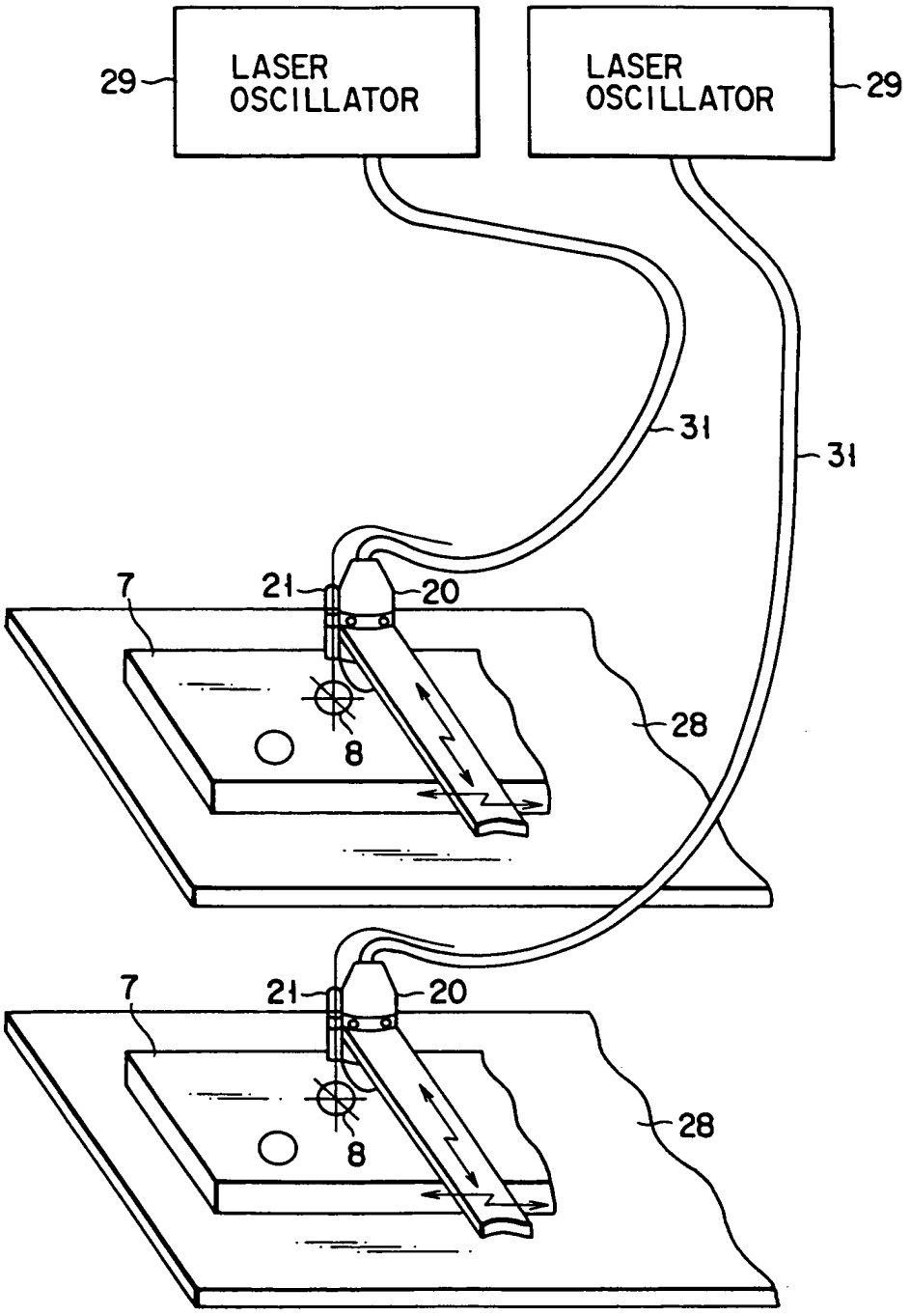

LASER OSCILLATOR
29
LASER OSCILLATOR
29
31
31
7
21
20
28
8
7
21
20
28
8

FIG. 26